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FEAP: Railroad Track Maintenance
Management System

Maintenance Management of U.S. Army Railroad Networks—the RAILER System: Demonstration of System Setup at Fort Stewart, GA

by
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The Railroad Maintenance Management System (RAILER), a member of the Engineered Management System (EMS) family, is being developed to support installation Directorates of Engineering and Housing in managing maintenance and repair activities for railroad track networks.

This report documents the successful implementation of RAILER version 2.0 at Fort Stewart, GA, as part of the Facilities Engineering Applications Program. Installation personnel found it immediately useful for railroad maintenance management decision support.

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FOREWORD

This demonstration was conducted for the U.S. Army Engineering and Housing Support Center (USAEHSC), under Facilities Engineering Applications Program (FEAP), Project F58, "Railroad Track Maintenance Management System (RAILER)." The work was conducted by the Engineering and Materials Division (EM), U.S. Army Construction Engineering Research Laboratory (USACERL). The USAEHSC Technical Monitor was Robert Williams, CEHSC-FB. His support is very much appreciated.

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Dr. Paul Howdyshell is Acting Chief of USACERL-EM. COL Everett R. Thomas is Commander and Director of USACERL, and Dr. L.R. Shaffer is Technical Director.

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1 INTRODUCTION

Background

The Railroad Maintenance Management System (RAILER) is a member of the Engineered Management System (EMS) family being developed to support installation Directorates of Engineering and Housing (DEHs) in managing maintenance and repair (M&R) activities for railroad track networks. As a decision support tool, RAILER can be used, in part, to analyze and evaluate track segments, determine and prioritize work needs, develop annual and long-range work plans, estimate maintenance and repair costs, and develop budgets. The system is intended to help the DEH schedule M&R in a way that allows the track to meet its mission at the least possible cost.

Developed at the U.S. Army Construction Engineering Research Laboratory (USACERL), RAILER includes field procedures for collecting data and a computer program for manipulating these data to facilitate maintenance management decisions. While an interim version (1.0) of RAILER[1] had been tested successfully at several U.S. Army installations, the current version 2.0 included several modifications and additional capabilities that had not been demonstrated within a DEH organization. For example, the track inspection procedures[2] had been greatly enhanced to capture all of the track defects specified in the Army Track Maintenance Standards.[3] The inventory procedures had also been revised.[4] Another capability of RAILER version 2.0 that had not yet been demonstrated was the customization of maintenance policies. To support these changes and enhancements, the RAILER computer software also had been largely rewritten for version 2.0.

To ensure that these new features would meet the DEH needs, Fort Stewart, GA was chosen as a demonstration site for RAILER version 2.0. This implementation was conducted as part of the FY87 Facilities Engineering Applications Program (FEAP).

Objective

The threefold objective of this FEAP demonstration was to:

1. Implement RAILER'S data collection and computer procedures, especially the recent enhancements and modifications of version 2.0. In the field, these activities include the inventory and inspection procedures, and on the computer, they include data entry and report (information and analysis) generation.

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[1] D.R. Uzarski, D.E. Plotkin, and D.G. Brown, *The RAILER System for Maintenance Management of U.S. Army Railroad Networks: RAILER I Description and Use*, Technical Report (TR) M-88/18/ADA199859 (U.S. Army Construction Engineering Research Laboratory [USACERL], 1988).

[2] D.R. Uzarski, D.G. Brown, R.W. Harris, and D.E. Plotkin, *Maintenance Management of U.S. Army Railroad Networks—The RAILER System: Detailed Track Inspection Manual*, Draft TR (USACERL, 1988).

[3] Technical Manual (TM) 5-628, *Railroad Track Standards*, Draft (Headquarters, Department of the Army [HQDA], March 1988).

[4] D.R. Uzarski, D.E. Plotkin, and D.G. Brown, *Maintenance Management of U.S. Army Railroad Networks—The RAILER System: Component Identification and Inventory Procedures*, TR M-88/13/ADA200276 (USACERL, 1988).

2. Test the ability of the computer software and field procedures to work together in providing maintenance management decision support.

3. Establish a working implementation of RAILER version 2.0 to permit an effective, practical evaluation of RAILER by both the prospective users and system developers.

Approach

A full implementation of RAILER version 2.0 was performed at Fort Stewart by USACERL personnel with assistance from the U.S. Army Engineering and Housing Support Center (USAEHSC) and the installation DEH. The demonstration was conducted following an approach that would be expected from a private contractor; this process permitted USACERL and USAEHSC to develop guidelines for future contract implementations of RAILER at other sites.

During this FEAP demonstration, USACERL collected data on RAILER's performance and the users' reactions. This feedback is being used to refine RAILER and has suggested forthcoming enhancements.

Scope

This report describes only the implementation and initial use phase of RAILER version 2.0 at Fort Stewart, including system turnover to the installation. It does not include a long-term case history of RAILER's use at Fort Stewart.

Mode of Technology Transfer

It is expected that RAILER will be implemented at more sites by private contractors under the guidance of USAEHSC. These implementations will include training for installation personnel. A RAILER course, jointly developed by USAEHSC and USACERL, will provide more training. As this report goes into final publication, RAILER version 3.01 has been released for general implementation on domestic Army installations. It is available to Army installations through the USAEHSC. For more information contact:

U.S. Army Engineering and Housing Support Center
ATTN: CEHSC-FB-P
Fort Belvoir, VA 22060

RAILER version 3.01 has also been released for general use, and is available through the RAILER support center at the University of Illinois. For more information contact:

University of Illinois at Urbana-Champaign
Conferences and Institutes
ATTN: RAILER Support Center
302 East John Street, Suite 202
Champaign, IL 61820

2 FIELD WORK

The field work required to implement RAILER includes stationing and segmenting the installation railroad network, and collecting data which is later entered into the computer. Stationing establishes a location referencing system for each track in the network. The track segment is the maintenance management unit within RAILER; segmentation is concerned with dividing each track into one or more track segments. Most of the data collection effort is devoted to inventory and inspection; other data are collected on traffic, installation, work history, and maintenance policy. For this demonstration, the inventory, inspection, installation, and traffic information was collected on one trip. The maintenance policy data was gathered during a second visit; the work history data collection was left for installation personnel to complete.

Procedures for stationing, segmenting, and collecting inventory data are documented elsewhere,[5] as are the detailed inspection procedures.[6] Procedures for collecting other data elements are documented for an earlier version of RAILER[7] (they are largely the same for version 2.0). The effective, efficient use of all procedures requires some office preparation before going to the field.

Office Preparation

Office preparation involves becoming familiar with the track network layout (including identifying all tracks and estimating their lengths), establishing a preliminary track segmentation (and component identification), acquiring and organizing supplies, and developing a work plan to be followed in the field. All of these activities require information about the installation network. In the case of Fort Stewart, this information was obtained from the most recent Military Traffic Management Command Transportation Engineering Agency (MTMC-TEA) installation Transportation System Capability Study (TSCS)[8] and from other maps previously acquired from the Fort Stewart DEH.

The office preparation for this demonstration was conducted at USACERL. Table 1 lists time requirements for the various office preparation activities. While all these functions were performed by engineers, most could be done by properly trained technicians.

Preliminary Track Segmentation

Table 2 summarizes the preliminary track segmentation based on the maps and lists track length estimates. As discussed below, this preliminary segmentation was later modified in the field.

In addition to track segments, two other track components--turnouts and curves--are given identification (ID) numbers within RAILER. These numbers were also assigned during the preliminary track segmentation. The turnout ID numbers were taken from a preexisting numbering sequence found

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[5] D.R. Uzarski, D.E. Plotkin, and D.G. Brown, TR M-88/13.

[6] D.R. Uzarski, D.G. Brown, R.W. Harris, and D.E. Plotkin.

[7] D.R. Uzarski, D.E. Plotkin, and D.G. Brown, TR M-88/18.

[8] *Installation Outloading Capability Study: Fort Stewart, Georgia and Camp Blanding, Florida*, MTMC Report TE 81-3a-42 (Military Traffic Management Command Transportation Engineering Agency [MTMC-TEA], July 1982).

Table 1

Office Preparation Activities and Time Required

Function	Manhours
Preliminary Track Segmentation:	
Reproducing, reviewing and correlating available maps for track verification and numbering	5
Segmenting the network	6
Estimating track lengths (for estimating station plate requirements and work plan)	5
Assigning turnout and curve ID numbers	1
Review by rest of staff	2
Drawing up and distributing track diagram (Appendix A)	2
	21
Supplies:	
Organizing station plates for individual tracks	11
Determining supply requirements	3
Acquiring supplies	3
Reviewing track cart assembly procedures	4
Preparing supplies for shipment to Fort Stewart	4
Reproduction and distribution of data collection forms	2
	27
Work Plan:	
Formulating plan	4
Communicating with staff at meeting (8 people)	10
	14
Total	62

on maps supplied by the Fort Stewart DEH. The track segment and curve ID numbers were assigned using established RAILER procedures.[9]

After the network was segmented, a track diagram was created that included the ID numbers for all tracks, track segments, turnouts, and curves (see Appendix A). Copies of this diagram and the segmentation summary (Table 2) were distributed to all personnel who would be going into the field.

Supplies

The supplies taken to Fort Stewart were based on expected tasks, network size, and crew size. The equipment required for track inspection is documented elsewhere.[10] Additional equipment included a hammer, nails, station plates, and the track cart for stationing. Supplies for personal comfort included bug repellant, sun screen, and coolers for liquid refreshment. The required number of data collection forms,

[9] D.R. Uzarski, D.E. Plotkin, and D.G. Brown, TR M-88/13.
[10] D.R. Uzarski, D.G. Brown, R.W. Harris, and D.E. Plotkin.

Table 2

Preliminary Track Segmentation

Track Number		Length (ft)	Number of Segments
1		3000	3
2		1100	1
3		4800	8
4		2600	2
5		300	1
6	(Not used)	-	-
7		900	1
8		1400	1
9		3000	4
10		8400	9
11		500	1
12		1400	1
13		1450	2
14		2600	1
15		2200	1
L		32700	3
P		2400	1
Y		1000	1
17	(Total used)	69750	41

crayons, paint markers, and station plates is primarily a function of network size. For each of these items, more than the number estimated were brought to avoid a shortage. In the case of most forms, the amount packed was 150 percent of the estimated required quantity, based on network size (Table 2).

Some supplies, such as station plates, need to be organized as part of office preparation. During track stationing, a prenumbered embossed station plate is attached to the track every 200 ft,* with a new numbering sequence beginning at 0+00 for each track.[11] The station plates used at Fort Stewart were taken from an existing supply at USACERL. The plates for each track were strung together on a separate wire in numerical order, beginning with the 0+00 plate. For example, based on the preliminary track length estimates (Table 2), Track 1 was expected to require 15 station plates ending with a 30+00 plate. Extra plates were taken in case the track length estimates were in error or there were other tracks not represented on the available maps.

Work Plan

To complete the field work within a 10-workday schedule, a relatively large crew was involved in the main visit to Fort Stewart; it included eight persons from USACERL and one from USAEHSC. (Not all of the crew was present for the entire site visit, nor was everyone entirely devoted to implementation

* 1 ft = 0.305 m.

[11] D.R. Uzarski, D.E. Plotkin, and D.G. Brown. TR M-88/13.

activities during the visit.) The large crew size made a structured, but flexible, work plan even more important than usual. The initial work plan, developed by the project supervisor, is presented in Appendix B. The actual work schedule is discussed below.

Site Visits

The field work entailed three site visits to Fort Stewart. The various site visit activities during the first two visits are summarized in Table 3 along with the time required to complete each.

The first site visit to Fort Stewart for RAILER implementation was June 1 through 11, 1987. Activities of the individual crew members during this period are indicated in Table 4. Note that not all crew members were available during this entire period, either because they arrived later, departed early, or were given another related assignment (continued RAILER research and work at Hunter Army Airfield).

Each workday generally began at 0700 and ended at 1830 with short meetings. At the morning meeting, crew assignments were announced and the day's modified work plan was discussed. In the evening, actual accomplishments were summarized and compared with expected results, and feedback was solicited from all (especially crew leaders) for formulating the next day's work plan. More informal meetings were often conducted during the lunch break. All of these meetings were important for coordinating the activities of different crews who often did not see each other during the rest of the day.

Table 3

Site Visit Activity Times

Information Area	Manhours
Stationing	76.0
Track segment inventory	91.0
Track inspection	180.0
Traffic	1.0
Installation information	2.0
Maintenance policy (second site visit)	20.0
Total	370.0

Stationing

A portable track cart with an attached measuring wheel was used for almost all of the stationing at Fort Stewart (Figure 1). A crew of two performed the stationing, often accompanied and aided by the project supervisor and/or the inventory crew leader. As indicated in Table 4, stationing was completed during the first week of the site visit.

Table 4

Crew Work Calendar

	Major Activities					
Day	Travel and Equipment	Stationing and Segmenting	Inventory	Inspection	Administration and Documentation	Other Assignments
Monday June 1	DU, DP, DB, SW, & RH					
Tuesday June 2	MK, MB, JB, JH, SW, & RH	SW, RH, DU, & DB		DP	DU, DP, & DB	
Wednesday June 3		SW, RH, & DU	DB, MK, & MB	DP & JB	DU & DP	
Thursday June 4		SW, RH, & DU	DB, MK, & MB	DP & JB	DU & DP	
Friday June 5		SW, RH, DU, DB, JB, & JH		DP, JB, MK, & MB	DU & DP	
Sunday June 7				DP		
Monday June 8	JH		DB, MB, & JB	DP, DU, SW, MB, & JB	DU & DP	MK & RH
Tuesday June 9	DP		DB	DU, SW, JB, & MB	DU & DP	MK, RH, JB, & MB
Wednesday June 10				DU, DB, & JB	DU	SW, RH, MK, & MB
Thursday June 11	DU, DB, SW, RH, MK, MB, & JB					

DB: David Brown JB: John Borse MK: Mohammed Kahn
DP: Don Plotkin JH: Joe Hovell RH: Rich Harris
DU: Don Uzarski MB: Mike Britton SW: Sue Wagers

During the stationing procedure, all required inventory station locations were recorded on paper for later use by the inventory crew; they were also recorded on the rail web. Data included the beginning and end station locations of track segments, grade crossings, and obstructions; centerline locations for grade crossings and drainage structures; switch point locations; and the locations of rail weight changes. Obtaining these locations at this stage helped speed the inventory process that followed. In addition to recording station locations and attaching station plates, the stationing crew was responsible for placing mile posts and whistle posts on the main line into Fort Stewart.

During stationing, the crew leader generally managed the track cart and recorded station locations. The other crew member attached station plates. If other persons were available, they would help by marking locations on the rail, dispensing station plates, guarding traffic at road crossings, and looking for inventory items such as rail weight changes and drainage structures. Organizing the station plates sequentially on wires, as described above, greatly increased the efficiency of the stationing process.

Figure 1. Portable track cart with attached measuring wheel.

Segmenting

While stationing, it was found that changes were required in the preliminary track segmentation. The final segmentation of Fort Stewart is shown in Appendix C and summarized in Table 5. The three changes involved tracks L, 3, 6, 9, CR1, and CR2, and can be analyzed by comparing Appendices A and C, and Tables 2 and 5.

Installation personnel had previously established a two-part classification of the track network: (1) the lead track and passing siding, and (2) yard track, beginning at the switch points of turnout 1 (where tracks L, 3, and 10 come together). Under the usual RAILER segmentation guidelines, turnout 1 would have been included in segment L03 of lead track L. However, since this turnout is considered part of the yard track, it would be more logical to include it with yard track 3. Turnout 1 was therefore entered into the Fort Stewart RAILER database as a separate additional segment of track 3, and track segment L03 was defined as ending at the switchpoints of the turnout.

Table 5

Final Track Segmentation

Track Number	Length (ft)	Number of Segments
1	2922	3
2	1099	1
3	4844	9
4	2470	2
5	349	1
6	1375	3
7	313	1
8	1443	1
9	1555	2
10	8195	8
11	387	1
12	1364	1
13	2304	2
14	2413	1
15	1488	1
CR1	165	1
CR2	165	1
L	32639	3
P	2230	1
Y	778	1
20	68538	44

In the maps available to USACERL during office preparation, there was no track 6, and it was assumed that the ladder access track to tracks 5, 7, 8, and 9 was part of track 9--thus giving track 9 the four segments indicated in Table 2. However, installation personnel noted that the ladder track was track 6. Therefore, the preliminary track segmentation of track 9 was changed and track 6 was added; this change is reflected in Table 5 and Appendix C. For consistency, the conjunction of tracks 6, 8, and 9 at turnout 15 was segmented like the conjunction of tracks L, 3, and 10 described above. As a result, track 9 has two segments.

Crossover tracks are treated as separate tracks within RAILER only if the distance between last switch ties is at least 50 ft.[12] Most crossovers between relatively close tracks do not meet this criterion. Therefore, the three crossovers between tracks 1, 3, and 4 were not identified as separate tracks in the preliminary segmentation. However, in the field, it was determined that both crossovers between tracks 1 and 3 are long enough to be identified as separate tracks CR1 and CR2.

Inventory

Figure 2 is an example of a completed inventory data collection form used at Fort Stewart. Most of the Fort Stewart inventory data was collected by a three-person crew, with two people making appropriate measurements and the third entering data on the form. By starting one day later, the inventory crew was able to work on track segments after the stationing crew had completed its work. The inventory crew usually had a copy of the station location information previously recorded by the stationing crew, thus greatly reducing the workload and speeding the inventory process.

The inventory crew worked together for approximately 2-1/2 days while inventorying the yard tracks of Fort Stewart. During one day, the inventory crew leader worked with the stationing crew and project supervisor to simultaneously station and inventory the lead track and passing siding. The inventory crew leader later spent 1-1/2 days validating the data and checking for missing or clearly erroneous entries.

Inspection

Figures 3 through 10 are completed examples of the eight inspection forms used at Fort Stewart. The Tie, Turnout and Vegetation inspection forms had already been tested as part of the interim track inspection procedures of RAILER I.[13] However, the inspection forms for Crossings, Drainage Structures, Track Fastenings, Rail, and Roadway and Ballast had been just recently developed and pilot-tested in order to incorporate the remaining track defects specified in the Army Track Maintenance Standards.[14] The inspection procedures, especially for the five new component areas, were demonstrated on a total network basis as part of this project.

About 18 mandays were spent on track inspection at Fort Stewart. Several different inspection crews of 1, 2, 3, and 4 persons were used during the site visit; sometimes two crews were simultaneously inspecting different parts of the network. Because each inspection component area has its own separate inspection form, the inspectors tended to specialize in component areas. This also meant that most track segments were inspected in multiple passes, often by different inspectors.

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[12] D.R. Uzarski, D.E. Plotkin, and D.G. Brown, TR M-88/13.
[13] D.R. Uzarski, D.E. Plotkin, and D.G. Brown, TR M-88/18.
[14] TM 5-628, Draft.

TRACK SEGMENT #: 1401 RAILER II DATE: June 4, 1987

INSTALLATION NAME: Ft. Stewart TRACK SEGMENT INVENTORY INFORMATION

SEGMENT IDENTIFICATION

Begin Location (station)	End Location (station)	Track Category	Track Use	Track Rank	Preceding Track Segment Number(s)
0+93	25+06	(A) B	Acc Aux (L) Se St		1007

Comments:

BALLAST

Support Ballast Depth (inches)	Depth to Crib Ballast (inches)	Ballast Type
	Ø	Rock

Comments:

BRIDGES

Facility Number	Begin Location (station)	End Location (station)	Deck Type	Construction Type
			Open Ballast	
			Open Ballast	

Comments:

CLEARANCE RESTRICTIONS

Begin Location (station)	End Location (station)	Obstruction	Measurement (feet) Horiz.	Vert.

Comments:

CULVERTS

Centerline Location (station)	Size (inches)	Type	Material
17+07	30"	Box (Pipe)	Concrete
		Box Pipe	
		Box Pipe	
		Box Pipe	

Comments:

CURVES

Curve ID Number	Curvature (Degrees) 1	2	3	4	5	6	7	8	Avg	Max Desired Speed (m.p.h.)
2C14	13	18	13	14	14				14.4	5
1C14	7	9	8	13	14	10			10.2	5

Comments:

PLATES/FASTENINGS

Tie Plate Length (inches)	Tie Plate Shoulder	Rail Anchors (#/200 TF)	Cage Rods (#)
9	(SS) DS NS NO	100	8
	SS DS NS NO		
	SS DS NS NO		
	SS DS NS NO		

Comments:

RAIL

Weight (lbs/yd)	Section	Begin Location (Station)
85	ASIE	0+93

Comments:

RAIL CROSSING

Centerline Location (Station)	Crossing Segment Number	Rail Weight (lbs/yd)	Frog Type	Crossing Angle (degree)
			B MI SM	

Comments:

RELATED FACILITIES

Facility Number	Facility Type
	Ramp

Comments:

ROAD CROSSINGS

Road Name	Centerline Location (Station)	Road Crossing ID Number	Crossing Length (feet)	Crossing Type	Protection	Bolted Joints
					G F S N	N Y
					G F S N	N Y
					G F S N	N Y

Comments:

TIES

Cross Section (in. x in.)	Tie Quantity (#/200 TF)	Material Type
7 x 9	114	Wood

Comments:

TURNOUTS

Turnout ID Number	Switch Point Location (Station)	Direction	Point Length (LF)	Rail Weight (lbs/yd)	Frog Type	Frog Size	Guard Rail Length (LF)
		LH EQ RH			B SG RBM SP		
		LH EQ RH			B SG RBM SP		

Comments:

5/6/87
MRB

Figure 2. Completed track segment inventory form.

RAILER II INSPECTION
TIES

DATE: 6/9/87
INSPECTOR: S.K.W.

TRACK SEGMENT #	DEFECTIVE TIE CONDITIONS: CONSECUTIVE DEFECTIVE TIES — 2	3	4	5 or more	ALL JOINT TIES DEFECTIVE	AVERAGE SPACING PER RAIL LENGTH* > 22 in.	ROTATED OR SKEWED TIES	MISSING/ BUNCHED/BADLY SKEWED TIES (tie spacing along either Rail > 48 in.)	TOTAL DEFECTIVE TIES
1006	111	1			1	0	𝍸 111		
Check if no defects: ☐									
TOTAL	3	1	0	0	1	0	8	0	34
COMMENTS:									
1007	𝍸 111	11					𝍸 𝍸 𝍸 𝍸 11		
Check if no defects: ☐									
TOTAL	8	2	0	0	0	0	22	0	127
COMMENTS:									
1008	𝍸	1			1		𝍸 1111		
Check if no defects: ☐									
TOTAL	5	1	0	0	1	0	9	0	91
COMMENTS:									
1401	𝍸 1						1111		
Check if no defects: ☐									
TOTAL	6	0	0	0	0	0	4	0	54
COMMENTS:	Difficult to inspect — cars on track								

* 22 inches per tie is equivalent to 21.3 ties per 39' rail and 18 ties per 33' rail

5/27/87
MPB

Figure 3. Completed tie inspection form.

TRACK SEGMENT #: 102 | RAILER II INSPECTION TURNOUTS | DATE: 6/4/87

TURNOUT ID #: 6 | INSPECTOR: DEP

GENERAL		TIES	
Rail Weight changes within Turnout limits	(N) Y	# of Defective Ties in a row (worst case)	
Reversing Tangent Past Frog Less Than 50 Feet	(N) Y	# of Occurrences where Joint Ties are Defective	
Switch Difficult to Operate Com 2	N (Y)	# of Occurrences where Tie Spacing > 22 in.	
Flangeways Dirty or Fouled	(N) Y	# of Skewed Ties	
Crib Areas Dirty or Fouled	N (Y)	# of Missing/Bunched/Badly Skewed Ties (Tie spacing along either rail > 48 in.)	
Line & Surface: Good (Fair) Poor		TOTAL # of Defective Ties Com 3	Ø

	COMPONENTS	NO DEFECTS	IMPROPER SIZE/ TYPE/POSITION/ DESIGN (Y or #)	LOOSE (Y or #)	CHIPPED/WORN/BENT/ CRACKED/BROKEN/ CORRODED/ALTERED (Y or #)	MISSING (Y or #)
S W I T C H S T A N D S	Switch Stand	Com 2	Y	Y	(Y)	Y
	Point Lock/Lever Latch	✓	Y	Y	Y	Y
	Connecting Rod	✓	Y	Y	Y	Y
	Switch Point - Left	Com 1	Y #	Y	Y	Y
	Switch Point - Right	Com 1	(Y #)	Y	Y	Y
	Switch Rods	Com 4 ✓				
	Rod & Clip Bolts	Com 5 ✓				
	Cotter Keys					ALL
	Slide Plates	Com 4 ✓				
	Braces	Com 6 ✓				
	Heel Filler & Bolts			5		
	Joint Bars/Shoulder Bars	✓				
FROG	Point & Top Surface	✓	Y	Y	Y #	Y
	Bolts	Com 6				
GUARDRAILS	Guard Rails	✓				
	Filler & Bolts	✓				

	MEASUREMENTS (inches)	STRAIGHT SIDE	TURNOUT SIDE
FROG +	Gage at Point	56.6	57.0
	Guard Check Gage	54.5	54.7
	Guard Face Gage	52.7	52.9
	Flangeway Width	1.9	1.8
	Flangeway Depth	Com 7	
GUARDRAILS +	Flangeway Width	2.0	2.5
OTHER	Gage at Switch Points	57.2	
	Gage at Joints in Curved Closure Rails	57.8	

COMMENTS:

1: Points are high.
2: Stand handle bent.
3: All ties covered by dirt or asphalt
4: Needs cleaning around rods and slide plates
5: Right no. 1 clip has two washers between clip & point
6: Buried in dirt
7: Flangeways need cleaning

See reverse for illustrations of wear and improper positions
+ See reverse for illustrations of measurements
See reverse for fraction/decimal conversion table

5/27/87 MRB

Figure 4. Completed turnout inspection form.

RAILER II INSPECTION
VEGETATION

DATE: 6/7/87
INSPECTOR: MB

TRACK SEGMENTS	DEFECTS	LOCATION * Left Occurrences	Left Total	Center Occurrences	Center Total	Right Occurrences	Right Total
1007	No Defects		X		X		
	Insufficient, where needed						
	Growing in Ballast					11	2
	Prevents Track Inspection						
	Interferes with Walking						
	Interferes with Visibility of Signs						
	Brushes Sides of Rolling Stock						
	Interferes with Trains or Track Vehicles						
	Presents a Fire Hazard						
	COMMENTS:						
1008	No Defects				X		X
	Insufficient, where needed						
	Growing in Ballast	1	1				
	Prevents Track Inspection						
	Interferes with Walking						
	Interferes with Visibility of Signs						
	Brushes Sides of Rolling Stock						
	Interferes with Trains or Track Vehicles						
	Presents a Fire Hazard						
	COMMENTS:						
1101	No Defects						
	Insufficient, where needed						
	Growing in Ballast	III	3	1	1	11	2
	Prevents Track Inspection						
	Interferes with Walking						
	Interferes with Visibility of Signs						
	Brushes Sides of Rolling Stock						
	Interferes with Trains or Track Vehicles						
	Presents a Fire Hazard						
	COMMENTS: Some vine type plant growing on sides of track in ballast						
L03* * Mi. los Pkway to T.O. (1)	No Defects						
	Insufficient, where needed						
	Growing in Ballast	IIII	8	1	1	IIII	5
	Prevents Track Inspection						
	Interferes with Walking						
	Interferes with Visibility of Signs						
	Brushes Sides of Rolling Stock						
	Interferes with Trains or Track Vehicles						
	Presents a Fire Hazard						
	COMMENTS:						

* See reverse for illustrations of location.

5/27/87
MDO

Figure 5. Completed vegetation inspection form.

RAILER II INSPECTION
ROAD AND RAIL CROSSINGS

DATE: 6/7-8/87
INSPECTOR: DEP

TRACK SEGMENT#	TYPE	ROAD NAME OR CROSSING SEGMENT#	MINIMUM FLANGE WAY DEPTHS	MINIMUM FLANGE WAY WIDTHS	FOULED FLANGE -WAYS	OCCURRENCES OF RELATED TRACK MATERIAL DEFECTS* (RAIL CROSSINGS ONLY)		SIGNS AND SIGNALS INOPERATIONAL, OBSCURED, OR MISSING	COMMENTS
							TOTAL		
L03	(ROAD) RAIL	Shaw Rd	2½	2½	(Y) N			(Y) N	
11	(ROAD) RAIL	Rt 82	1.8	2.5	(Y) N			(Y) N	
11	(ROAD) RAIL	Dirt Xing	2.5	2	(Y) N			(Y) N	No sign, (commissary ?)
11	(ROAD) RAIL	Glennbryan	4.5	1½	(Y) N			(Y) N	
11	(ROAD) RAIL	Eunice Rd	3.2	----	(Y) N			(Y) N	Dirt partly fills flangeways
11	(ROAD) RAIL	Dirt Road	----	----	Y (N)	Partly		(Y) N	
11	(ROAD) RAIL	Miles Pkwy	----	----	Y N			Y N	
	ROAD RAIL		----	----	Y N			Y N	
1302	(ROAD) RAIL	Sta 11+17	----	2"	(Y) N			(Y) N	Dirt fills flangeways
302	(ROAD) RAIL	Sta 14+3	----	----	(Y) N			(Y) N	To Equip yard Dirt Xing
	ROAD RAIL		----	----	Y N			Y N	
	ROAD RAIL		----	----	Y N			Y N	
	ROAD RAIL		----	----	Y N			Y N	
	ROAD RAIL		----	----	Y N			Y N	
	ROAD RAIL		----	----	Y N			Y N	
	ROAD RAIL		----	----	Y N			Y N	
	ROAD RAIL		----	----	Y N			Y N	

* Includes Improper Size/Type/Position, Chipped/Worn/Bent/Cracked/Broken/Corroded/Altered (including Flame Cut), Loose and Missing

See reverse for fraction/decimal conversion table

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MRB

Figure 6. Completed road and rail crossings inspection form.

RAILER II INSPECTION
DRAINAGE STRUCTURES

DATE: 6/5/87
INSPECTOR: MRB

TRACK SEGMENT#	LOCATION (NEAREST 100' STATION)	STRUCTURE TYPE*	STRUCTURE CONDITION	INSUFFICIENT SIZE FOR MAX WATER FLOW	WATER FLOW OBSTRUCTED OR INADEQUATE	HAZARD TO PERSONNEL	COMMENTS
1008	61+25	Culvert	(S) U	(N) Y	N (Y)	(N) Y	Erosion around edge of pipe. Both ends obstructed
1008	74+92	"	(S) U	(N) Y	(N) Y	(N) Y	Half full with standing water
1401	17+20	"	S (U)	(N) Y	(N) Y	(N) Y	Half full with standing water, pipe separated
1001	6+74	"	(S) U	(N) Y	(N) Y	(N) Y	Quarter full with standing water, Heavy vegetation
1001	3+40	"	(S) U	(N) Y	(N) Y	(N) Y	Heavy Vegetation
501	2+24	"	(S) U	(N) Y	N (Y)	(N) Y	Water standing, Ends obstructed by veg & concrete
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	
			S U	N Y	N Y	N Y	

* Examples are Culvert, Ditch, Drain, Storm Sewer, and Drop Inlet

5/27/87
MRB

Figure 7. Completed drainage structures inspection form.

RAILER II INSPECTION
TIE PLATES, RAIL FASTENINGS AND JOINTS

DATE: 6/8/87
INSPECTOR: DRU

TRACK SEGMENT#	COMPONENTS	IMPROPER SIZE/TYPE Occurrences	IMPROPER SIZE/TYPE Total	FLAMECUT/ALTERED Occurrences	FLAMECUT/ALTERED Total	MISSING/INSUFFICIENT NUMBER/CRACKED/BROKEN Occurrences	MISSING/INSUFFICIENT NUMBER/CRACKED/BROKEN Total	IMPROPERLY INSTALLED OR LOOSE Occurrences	IMPROPERLY INSTALLED OR LOOSE Total
102	Tie Plates ‡								
	Spikes * ‡								
Check if no defects:	Joint Bars								
	Joint Bolts								
[X]	Compromise Bars								
	Rail Anchors * ‡								
	Gage Rods								
306	Tie Plates ‡								
	Spikes * ‡								
Check if no defects:	Joint Bars								
	Joint Bolts							11	2
[ ]	Compromise Bars								
	Rail Anchors * ‡								
	Gage Rods								
CR201	Tie Plates ‡								
	Spikes * ‡								
Check if no defects:	Joint Bars								
	Joint Bolts								
[ ]	Compromise Bars								
	Rail Anchors * ‡								
	Gage Rods								
1201	Tie Plates ‡					1	1		
	Spikes * ‡							1	1
Check if no defects:	Joint Bars			1	1	1	1		
	Joint Bolts	11	2					111	3
[ ]	Compromise Bars								
	Rail Anchors * ‡								
	Gage Rods							1	1

	Occurrences	Total
All Joint Bolts Missing or Broken for a Rail End		
Rail End Mismatch Exceeds 3/16"		
Rail End Gap Exceeds 1" but not 2"		
Rail End Gap Exceeds 2"		

COMMENTS: Virtually all plates spikes and bolts covered with soil and ballast

	Occurrences	Total
All Joint Bolts Missing or Broken for a Rail End		
Rail End Mismatch Exceeds 3/16"		
Rail End Gap Exceeds 1" but not 2"		
Rail End Gap Exceeds 2"		

COMMENTS: Most plates and spikes covered with ballast

	Occurrences	Total
All Joint Bolts Missing or Broken for a Rail End		
Rail End Mismatch Exceeds 3/16"		
Rail End Gap Exceeds 1" but not 2"		
Rail End Gap Exceeds 2"		

COMMENTS: Cross over embedded in asphalt concrete

	Occurrences	Total
All Joint Bolts Missing or Broken for a Rail End		
Rail End Mismatch Exceeds 3/16"		
Rail End Gap Exceeds 1" but not 2"	11	2
Rail End Gap Exceeds 2"		

COMMENTS: Virtually all plates and spikes covered with soil & ballast

* See reverse for Spiking and Rail Anchor Patterns.
‡ If defect exists continuously over significant track length, place "1" under "Occurrences" and in "COMMENTS" enter the beginning and ending station locations, along with defect type.

5/27/87
KFR

Figure 8. Completed track fastenings inspection form.

INSTALLATION NAME: _____

RAILER II INSPECTION
RAIL

DATE: 6/3/87
INSPECTOR: DEP

TRACK SEGMENT NUMBER	DATE	LOCATION (STATION)	RAIL (LEFT OR RIGHT)	DEFECT TYPE	COMMENTS
1003				0	
1004				0	
1501				0	
1006				0	
1007				0	
Y01		2 1+25	L	21	
301				0	
302				0	
303		T.O. 3		17	ST Closure
304				0	
305				0	
1009				0	
1401				0	
1001		T.O. 12		17	ST Closure
1001		T.O. 12		5	ST Closure
1002		12+10	L	23	In gage corner
1002		13+50	L	23	In gage corner
1001		5+80	R	21	
1001		5+50	L	21	Deep - top of head

RAIL DEFECT TYPES

0 = No Rail Defects in Segment
1 = Bolt Hole Crack
2 = Broken Base
3 = Corroded Base
4 = Complete Break
5 = Crushed Head
6 = Defective Weld
7 = End Batter (>1/4")
8 = Fissure - Compound
9 = Fissure - Transverse
10 = Fracture - Detail
11 = Fracture - Engine Burn
12 = Head/Web Separation
13 = Piped Rail
14 = Split Head - Horizontal
15 = Split Head - Vertical
16 = Split Web
17 = Torch Cut
18 = Wear - Side (>1/2")
19 = Wear - Vertical (>1/2")
20 = Overflow
21 = Shelling
22 = Corrugation
23 = Chip/Dent in Head
24 = Engine Burn
25 = Flaking
26 = Rail Weight Insufficient for Mission
27 = Rail Less Than 13 Feet Long

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MRB

Figure 9. Completed rail inspection form.

RAILER II INSPECTION
ROADWAY AND BALLAST

DATE: 05/28/87
INSPECTOR: [illegible]

TRACK SEGMENT#	ITEM	Hazardous to Train Movement Occurrences	Total	Not Hazardous Occurrences	Total
1007	Ballast/Subgrade Pumping				
	Insufficient Ballast				
Check if no defects:	Erosion of Embankments and Cut Slopes				
	Embankment Sliding or Slippage				
[X]	Potential Slope Stability Problems				
	Settlement at Approaches to Bridges				
	Washouts Under the Track				

Percent of Dirty or Poorly Draining Ballast to Nearest 10% : 30%

COMMENTS: [illegible] in good condition

1008	Ballast/Subgrade Pumping				
	Insufficient Ballast				
Check if no defects:	Erosion of Embankments and Cut Slopes				
	Embankment Sliding or Slippage				
[X]	Potential Slope Stability Problems				
	Settlement at Approaches to Bridges				
	Washouts Under the Track				

Percent of Dirty or Poorly Draining Ballast to Nearest 10% : 20%

COMMENTS: Generally in good condition.

1101	Ballast/Subgrade Pumping				
	Insufficient Ballast				
Check if no defects:	Erosion of Embankments and Cut Slopes				
	Embankment Sliding or Slippage				
[X]	Potential Slope Stability Problems				
	Settlement at Approaches to Bridges				
	Washouts Under the Track				

Percent of Dirty or Poorly Draining Ballast to Nearest 10% : 80%

COMMENTS: Ballast dirty otherwise generally track is O K

602	Ballast/Subgrade Pumping				
	Insufficient Ballast				
Check if no defects:	Erosion of Embankments and Cut Slopes				
	Embankment Sliding or Slippage				
[X]	Potential Slope Stability Problems				
	Settlement at Approaches to Bridges				
	Washouts Under the Track				

Percent of Dirty or Poorly Draining Ballast to Nearest 10% : 20%

COMMENTS: In good condition

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Figure 10. Completed roadway and ballast inspection form.

Before the demonstration at Fort Stewart, the track inspection procedures had been fully tested with railroad trackage of various quality levels. However, the procedures had not been implemented previously on such a large scale. As a result of the experience at Fort Stewart, the track inspection procedures were significantly modified. First, they were simplified, primarily by collapsing four of the previous inspection areas (Crossings, Drainage Structures, Track Fastenings, and Roadway and Ballast) into one called "Other Track Components." Even after simplification, the procedures were judged to be too time-consuming for regular network implementation, but were still appropriate for "project level" management which focuses on individual track segments scheduled for M&R in the near future. Therefore, the inspection forms were reorganized so that a given form was not shared by multiple segments (as was the case in Figures 3 and 5 through 10). Instead, multiple inspection areas were combined on one form for a single track segment. Additional modifications in the inspection procedures were required due to new changes in the Army Track Standards.[15] The new inspection forms and data collection procedures are described elsewhere.[16]

Traffic Information

The inventory crew leader spent 1 hr obtaining traffic information from the Installation Transportation Office (ITO) at Fort Stewart. This information can be used for several purposes within RAILER, such as prioritizing track segments, structural analysis, and forecasting track condition.

Only total installation traffic volumes were available for a few car types at Fort Stewart; these data were not broken down by specific tracks. As a result, before being entered into the database, the traffic volume had to be allocated among the functional (nonaccess) track segments. This allocation was based on other information obtained from the ITO. For example, the total installation heavy flat car volume was about 700 cars/year. Since the track vehicles, which these cars usually carry, are generally loaded and unloaded on tracks 10 and 14, it was assumed that the heavy flat car volume for each of these tracks was 350 cars/year (Figure 11).

Information obtained from the ITO was also helpful in verifying track usage and determining the operating speed through curves (two inventory data elements).

Installation Information

The inventory crew leader also spent about 2 hr obtaining installation information from a variety of sources. The completed Installation Information form is shown in Figure 12. The installation number and relation code were obtained from the DEH office and were later verified with other sources available at USACERL. The serving railroad nearest yard information was obtained from the Fort Stewart Yard Master. The rest of the serving railroad information was acquired by a telephone call to the railroad. Much of the serving railroad information was verified with MTMC documentation.[17]

Maintenance Policy Data

A maintenance policy specifies what actions (if any) are taken for each defect type/track category combination, and includes a cost estimate for that action on a per-defect occurrence basis. An installation may have more than one maintenance policy. For example, one policy may indicate only the minimal

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[15] TM 5-628, Draft.

[16] D.R. Uzarski, D.G. Brown, R.W. Harris, and D.E. Plotkin.

[17] *Civil Rail Lines Important to National Defense* (MTMC, July 1986).

INSTALLATION NAME: Ft. Stewart RAILER II TRAFFIC INFORMATION DATE: June 87

Complete Car Type Information for LOADING, SERVICE, and STORAGE Tracks only.
Car Type options are FLAT, HEAVY FLAT, BOX, HOPPER, GONDOLA, 6 AXLE LOCOMOTIVE, 4 AXLE LOCOMOTIVE, and 2 AXLE LOCOMOTIVE.
List all Car Types that are appropriate for each Track Segment.
For cars, "Heaviest Load" is the heaviest loading (net tons) placed on the car; for locomotives, "Heaviest Load" is the total weight (gross tons) of the locomotive.

Track Segment #	Car Type	# of Cars Per Month	Heaviest Load (Tons)	Track Segment #	Car Type	# Of Cars Per Month	Heaviest Load (Tons)
2	Flat	120	45				
3	Flat	"	"				
8	Flat	"	"				
9	Flat	"	"				
10	Heavy Flat	350	120				
14	" "	"	"				
12	Hopper	200	100				
13	Flat	10	85				
4	All cars		Ø				
7	"		Ø				
11	"		Ø				

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Figure 11. Completed traffic information form.

RAILER II
INSTALLATION INFORMATION

DATE:_____

INSTALLATION INFORMATION			
INSTALLATION NUMBER	RELATION CODE	INSTALLATION NAME	STATE CODE
13305	13305	Ft. Stewart	GA

SERVING RAILROAD(S) INFORMATION				
COMPANY NAME	COMPANY CODE	NEAREST YARD		
		LOCATION	DIRECTION	HIGHWAY DISTANCE (> 25 miles)
Seaboard System	SBD	Jesup	SW	(N) Y
				N Y

SERVING RAILROAD TRACKAGE			
COMPANY CODE	TRACK DESIGNATION	TRACK LENGTH	MOBILIZATION CAPABLE
SBD		0.5	Yes

INSTALLATION TRACKAGE

TRACK NUMBER	TRACK LENGTH	NUMBER OF SEGMENTS	TRACK NUMBER	TRACK LENGTH	NUMBER OF SEGMENTS	TRACK NUMBER	TRACK LENGTH	NUMBER OF SEGMENTS

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MRB

Figure 12. Completed installation information form.

short-term solutions required to bring all track into compliance with the Army Track Standards,[18] while another maintenance policy might specify the most efficient long or medium-term maintenance solutions. All maintenance policies will meet or exceed the minimum condition levels specified by the Army Track Standards.

A workbook developed at USACERL is used to help collect the maintenance policy information. Each defect is listed in the workbook, with columns used for different track categories.

Maintenance policy data were not collected during the first site visit. Instead, one engineer from USACERL returned to Fort Stewart during July 1988 to collect this information. He talked with two representatives from the Fort Stewart DEH--the roads, grounds, and railroad foreman and an assistant facility engineer. With these individuals, the USACERL engineer first discussed the concept of maintenance management policies and how to use the workbook. He then went through the workbook with them once, soliciting their maintenance actions for "in-house" and "contract" policies. They then worked back through the workbook to develop cost estimates. Some of these estimates required some research by the installation and were mailed to USACERL later. An example of one page for one of the policies is shown in Figure 13.

[18] *Installation Outloading Capability Study, Fort Stewart, Georgia and Camp Blanding, Florida.*

Total:

203 VEGETATION - INTERFERES WITH MOVEMENT OF TRAINS OR TRACK VEHICLES — 4 — 1

Track Category:
Restriction Number:
Work Action:
Work Type:
Unit Costs:
Material:
Labor:
Equipment:
Total:

300 NO DEFECTS

Track Category:
Restriction Number:
Work Action:
Work Type:
Unit Costs:
Material:
Labor:
Equipment
Total:

301 BOLT HOLE CRACK — 3 — 1

Track Category:
Restriction Number:
Work Action: Weld and redrill or replace
Work Type:
Unit Costs:
Material:
Labor:
Equipment:
Total:

302 BREAK - COMPLETE

Track Category:
Restriction Number:
Work Action:
Unit Costs:
Material:
Labor:
Equipment:
Total:

Figure 13. Page from Fort Stewart maintenance policy workbook.

3 DATA LOADING AND PROCESSING

The data loading and processing included several steps. All data collected at Fort Stewart, including that on maintenance policy, were first entered into the computer. Then RAILER information reports were run to verify the data and check for missing entries. After discrepancies were corrected, some of these reports were run again and are presented in Appendix D. This process was completed using RAILER version 2.0, running on an AT&T PC6300 computer (IBM-compatible) with a 20-mb hard disk. Although this work was done by an engineer, it could have easily been completed by a properly trained technician.

Data Entry

After creating the Fort Stewart RAILER database, the installation and inventory information was entered first, followed by inspection, traffic, and maintenance policy data. As indicated in Table 6, the inventory and inspection data entry took the most time, followed by the maintenance policy information.

For efficient data entry, the RAILER computer screens are designed to almost duplicate the data collection forms. However, after the primary site visit and before data entry, both the inventory and inspection procedures had been modified to the extent that the Fort Stewart data collection forms did not completely match the appropriate data entry computer screens. In the case of inventory data, this mismatch was slight and increased data entry times by, at most, 10 percent. However, as discussed in Chapter 2, the changes in the inspection procedures and form layouts were more significant, probably increasing data entry times by as much as 50 percent.

Table 6

Data Entry Times

Information Area	Manhours
Installation information	0.5
Track segment inventory	20.5
Track inspection	24.5
Maintenance policy	10.5
Traffic	0.7
Total	56.7

Therefore, it must be stressed that these two data entry values (inventory and inspection) in Table 6 do not reflect what should be expected at other RAILER implementations. Specifically, these values should be about 10 and 33 percent lower, respectively, if they are used to estimate data entry times for future RAILER implementations. The other data entry times presented in Table 6 were substantially unaffected by RAILER modifications.

As can be seen in Table 7, the time required to load segment inventory information varied greatly on a per-segment basis. The time required to enter these data, like the time required for collection, depends primarily on the complexity of the track segment. More specifically, the variability in per-segment loading times is mainly caused by differences in the numbers of grade crossings and loading docks (a related facility type). The values in Table 7 include only the initial data entry time spent keying in values and/or scrutinizing the forms; the values do not include the time spent correcting earlier mistakes or periodic breaks away from the computer screen. These latter times are included in the total inventory data entry time presented in the second line of Table 6.

Table 8 lists the inspection data entry times for Fort Stewart. The primary obstacle in entering these data was that the forms are generally organized by inspection area (see Figures 3 through 10), whereas the final (modified) procedures are organized mainly by track segment as discussed above. The variation in the inspection data entry times is mostly due to differences in the number of rail and joint defects, "other component" defects, and the presence of turnouts.

Data Verification and Processing

After the data were initially loaded, the following RAILER information reports were generated:

- Installation Network Information Report
- Track Segment Inventory Information Report
- Track Segment Inspection Information Report
- Traffic Information Report
- Policy Report.

These reports were then carefully compared with the data collection forms (and the collective memory of the implementation team) to look for discrepancies. The times required to compare each information area are presented in Table 9. Again, the inconsistencies between the forms used at Fort Stewart and the current procedures inflated the time requirements, possibly by as much as 20 percent.

It took about 3 hr to correct the discrepancies found. This is a relatively short time when compared with the initial data loading effort (see Table 6).

After the database was verified and corrected, three key reports were generated (Appendix D). The installation information and segment inventory reports define the more permanent characteristics of the network. The comparison reports provide a useful way to determine the track condition (relative to the track standards and based on track inspection) at different levels of detail.

Table 7

Inventory Data Loading Times*

Track Segment	Time (Min)	Track Segment	Time (Min)
101	30	1001	17
102	60	1002	10
103	10	1003	10
		1004	5
201	15	1005	10
		1006	**
301	15	1007	20
302	15	1008	15
303	15		
304	15	1101	15
305	15		
306	30	1201	15
307	10		
308	12	1301	25
309	30	1302	30
401	90	1401	15
402	**		
		1501	20
501	15		
		CR101	15
601	15		
602	10	CR201	15
603	30		
		L01	15
701	20	L02	10
		L03	120
801	30		
		P01	10
901	15		
902	15	Y01	15

*Summary statistics: average: 22 min; standard deviation: 21 min; median: 15 min; range: 5 to 120 min.
**Unknown times.

Table 8

Inspection Data Loading Times

Component Area	Average Time	Total Time (hr)
Ties	2.61 min/segment	1.9
Vegetation	2.27 min/segment	1.7
Turnouts	8.99 min/turnout	4.0
Rail and joint:		7.0
Defects	1.55 min/defect	
Defect-free segments	0.53 min/segment	
Other component:		9.9
Component defects	1.64 min/defect	
Flangeway measurements	1.70 min/crossing	
Impaired inspection	0.86 min/segment	

Table 9

Data Verification Times

Information Area	Manhours
Installation information	0.20
Track segment inventory	3.45
Track inspection	5.25
Maintenance policy	1.60
Traffic	0.50
Total	11.00

4 SYSTEM TURNOVER TO INSTALLATION PERSONNEL

After the Fort Stewart database had been validated against the data collection forms, RAILER was ready to be turned over to installation personnel. The turnover process included providing informal RAILER training.

The first step in the system turnover was to install the RAILER program and the Fort Stewart database on an IBM-compatible AT computer in the Fort Stewart DEH. Successful installation was verified by producing some RAILER reports which were compared with the same reports produced previously at USACERL.

After the RAILER program was installed, one Fort Stewart employee was formally trained on the computer while several others looked on. Later a briefing was presented on the entire RAILER system. During the system turnover, several Fort Stewart RAILER reports produced at USACERL were turned over. Installation personnel will later be formally trained on RAILER data collection procedures and the use of RAILER for track maintenance management.

While it is not within the scope of this document to report on the use of RAILER at Fort Stewart, it is anticipated that an ongoing liaison will continue between USACERL and Fort Stewart, possibly through a RAILER users' group.

5 CONCLUSIONS AND RECOMMENDATIONS

RAILER version 2.0 has been implemented successfully at Fort Stewart, GA as part of the FY88 FEAP. Installation personnel found it immediately useful for railroad maintenance management decision-support.

The data collection process was demonstrated, including segment inventory and track inspection procedures. The relatively new structured track inspection procedures based on the Army Track Standards worked as expected. They permitted thorough inspections with simplified recording and reporting, requiring less reliance on the inspector's memory while meeting the forthcoming regulatory requirements.[19] It was shown, however, that the inspection process is very labor-intensive and time-consuming.

The experience with the RAILER detailed track inspection at Fort Stewart suggested the need for two actions. First, as discussed in Chapter 2, the inspection procedures were modified, primarily by collapsing four of the previous inspection areas into one. However, the vast quantity of detailed data acquired with these new, detailed track inspection procedures was still more appropriate for project-level management than network-level management. Therefore, to efficiently support network-level management, simplified track inspection procedures are being developed at USACERL in conjunction with the Track Structure Condition Index (TSCI). These new procedures will use sampling techniques and have much fewer defect types with less location referencing requirements. The goal is to significantly reduce the inspection effort while still supporting the safety requirement of the Army Track Standards.

Based on the experience at Fort Stewart, it was concluded that the crew size can be greatly reduced. At future implementations, a crew size of two is usually sufficient, but a third member can increase the efficiency in some cases. Using a track cart, two people could quite adequately complete stationing and inventory during the same pass. On a second pass, these two persons could completely inspect the track (using the current detailed inspection procedures).

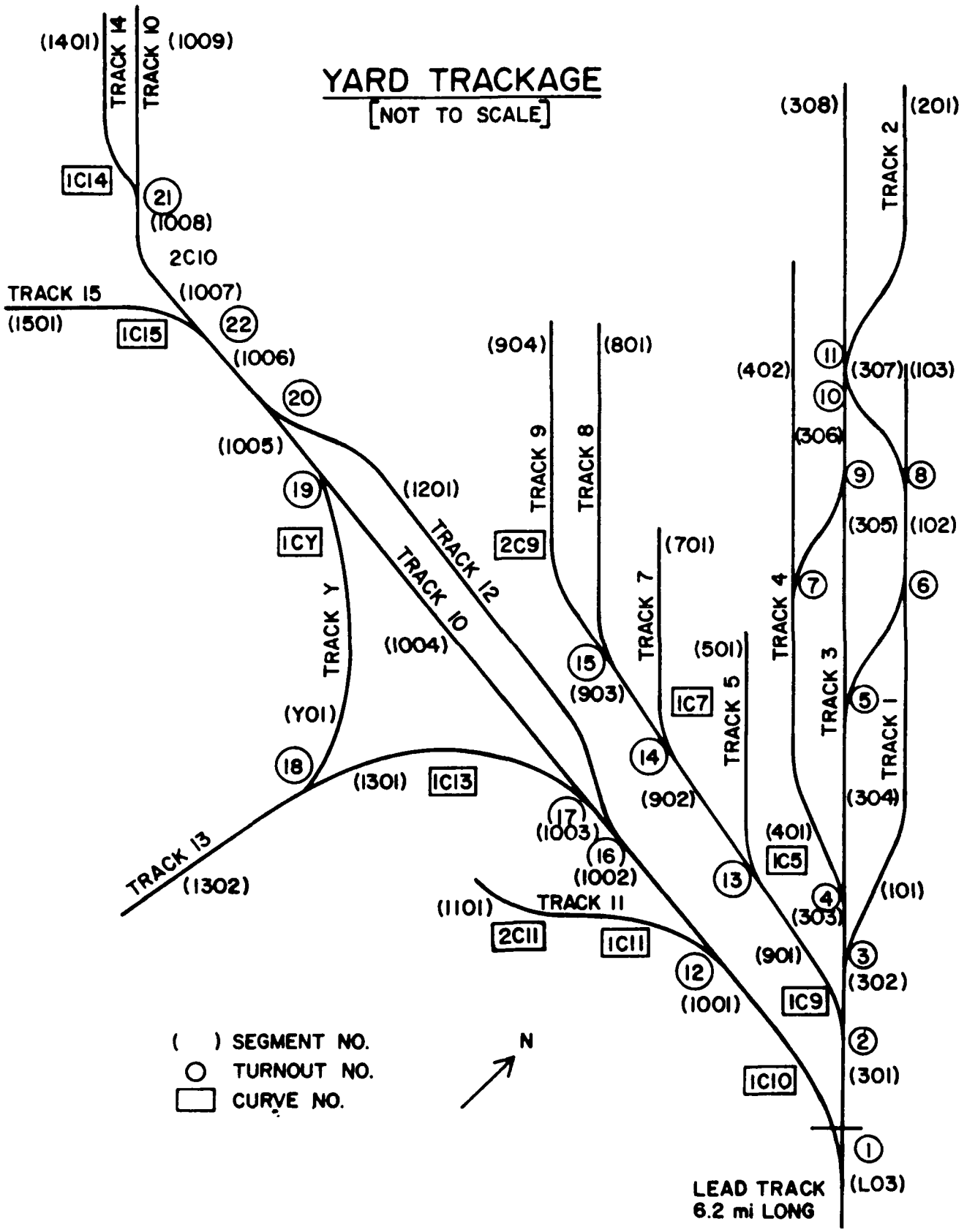
A third person could speed some tasks such as curve measurement (an inventory data element). More importantly, the third person could shorten the site visit by collecting the office information (such as installation, traffic, maintenance policy, and maintenance history information) while the other two crew members are in the field. However, it might be more advantageous to have the office information collected by crew members who have become familiar with the installation network through the track inspection.

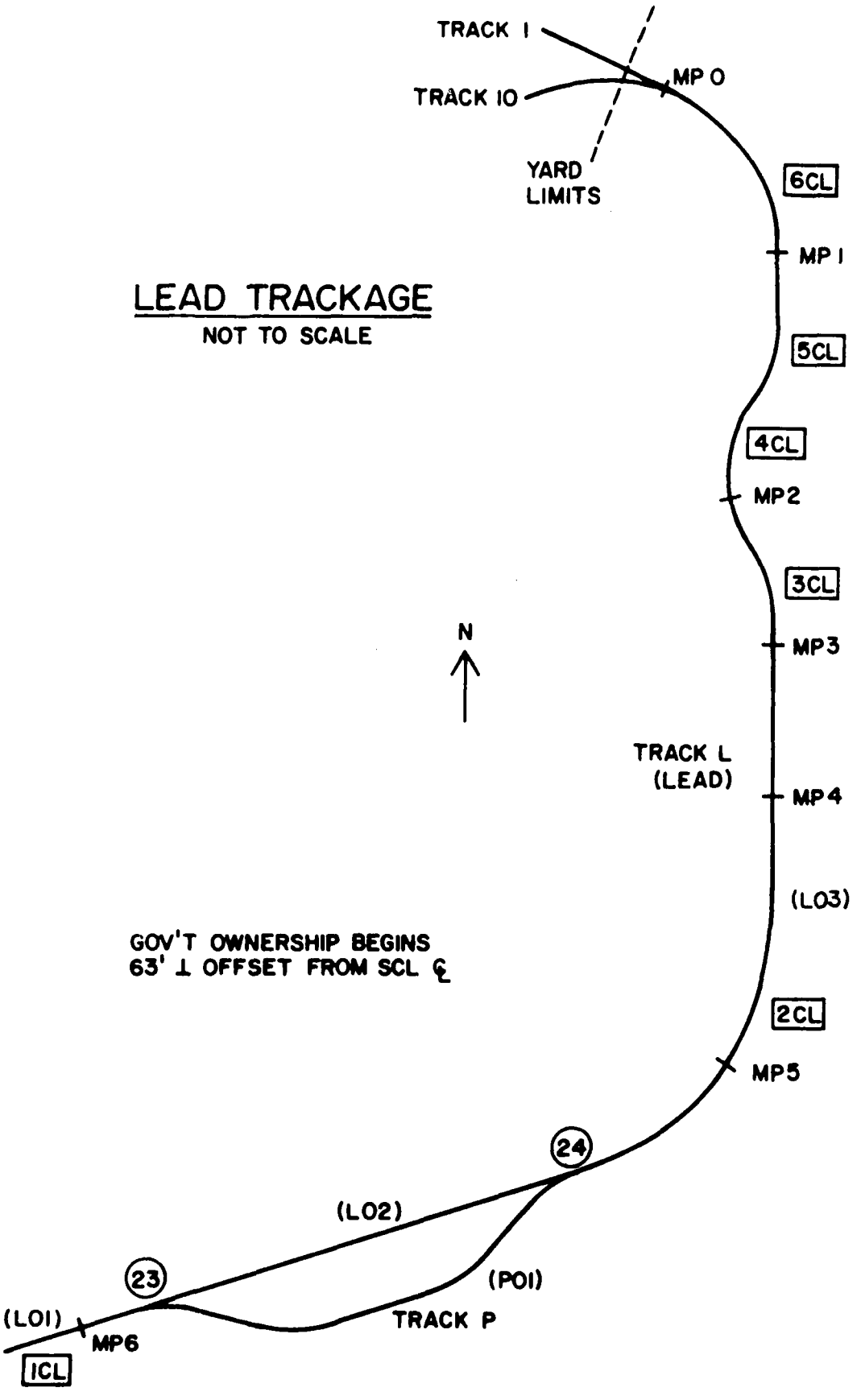
After evaluating the RAILER implementation at Fort Stewart, the system was judged ready for implementation on a contractual basis. During the following summer, RAILER was implemented by contract at another site as a FEAP project. As a result of these experiences, it is recommended that RAILER be released for general implementation on domestic Army installations.

[19] AR 420-72.

APPENDIX A:

PRELIMINARY SEGMENTED MAP


YARD TRACKAGE
[NOT TO SCALE]
(1401)
TRACK 14
TRACK 10
(1009)
1C14
21
(1008)
2C10
(1007)
TRACK 15
(1501)
1C15
22
(1006)
20
(1005)
19
1CY
TRACK Y
(Y01)
18
(1301)
1C13
TRACK 13
(1302)
(1201)
TRACK 12
TRACK 10
(1004)
(904)
TRACK 9
TRACK 8
(801)
2C9
15
(903)
(701)
TRACK 7
1C7
14
(902)
(501)
TRACK 5
17
(1003)
16
(1002)
(1101)
TRACK 11
2C11
1C11
12
(1001)
13
(401)
1C5
(308)
(201)
TRACK 2
(402)
11
(307)
(103)
10
(306)
9
8
(305)
(102)
TRACK 4
7
6
TRACK 3
5
TRACK 1
(304)
4
(303)
(101)
3
(302)
(901)
1C9
2
(301)
1C10
1
(L03)
LEAD TRACK
6.2 mi LONG
( ) SEGMENT NO.
O TURNOUT NO.
CURVE NO.
N


TRACK 1
TRACK 10
MP 0
YARD
LIMITS
6CL
MP 1
LEAD TRACKAGE
NOT TO SCALE
5CL
4CL
MP2
3CL
N
MP3
TRACK L
(LEAD)
MP4
(L03)
GOV'T OWNERSHIP BEGINS
63' ⊥ OFFSET FROM SCL ℄
2CL
MP5
24
(L02)
23
(P01)
(L01)
MP6
TRACK P
1CL

APPENDIX B:

INITIAL WORK PLAN

This appendix includes the initial crew assignments, responsibilities, and plan of action for the FEAP field work at Fort Stewart.

A. Assignments and responsibilities

1. Overall Supervision: Don Uzarski
   Assistance: Don Plotkin

   Responsibilities:

   a. Overall project responsibility (administrative and technical)
   b. Project planning
   c. Coordination with installation
   d. Crew coordination
   e. Personnel assignments

2. Stationing and Segment Verification

   Crew Leader: Sue Wagers
   Member: Rich Harris

   Responsibilities:

   a. Station the network
   b. Affix permanent markers
   c. Temporarily station with crayon key inventory components (switch point locations, culverts, etc.)
   d. Verify tracks on map

3. Inventory

   Crew Leader: Dave Brown
   Members: Mohammed Kahn, Mike Britton

   Responsibilities:

   a. Complete segment inventory
   b. Complete network inventory
   c. Collect required information for the computation of track ranks
   d. Collect traffic information
   e. Verify all track segment numbers, turnout numbers, and curve numbers on map

4. Inspection

   Crew Leader: Don Plotkin
   Members: Joe Hovell (USAEHSC), John Borse

Responsibilities:

a. Perform 100 percent track inspection of each segment
b. Inspect related facilities

B. Action Plan

1. The stationing crew, the inventory crew leader, and supervisor will leave on 1 June, with the rest of the group to leave the next day. This will ensure that the stationing crew stays ahead of the others.

2. Plan to return on the 11th.

3. Most personnel will serve on more than one crew since none of those tasks should last the entire period. It is expected that stationing and inventory will be completed during the first week. Inspection will carry over into the second week.

4. A short meeting will be held at the close of each day to discuss the events of the day and to outline the next day's efforts.

5. Crew leaders are responsible for the completeness and accuracy of their work. Data sheets will be reviewed daily. Errors will be corrected prior to departure.

6. Work hours will generally be between 0800 and 1730. The progress of the work will dictate what actually will be done. The weekend should be free unless work dictates otherwise. Prepare to work in the rain.

7. All work must be completed within the allotted time.

8. Three station wagons will be rented so that all of the equipment can be transported easily.

9. Crew leaders need to make sure that all of the materials, tools, etc. needed to do the work are taken along.

10. Equipment will be shipped beforehand. Mohammed Kahn will coordinate this effort with the crew leaders.

11. Initially, the stationing crew will use the track cart. After that, use will be determined based on need.

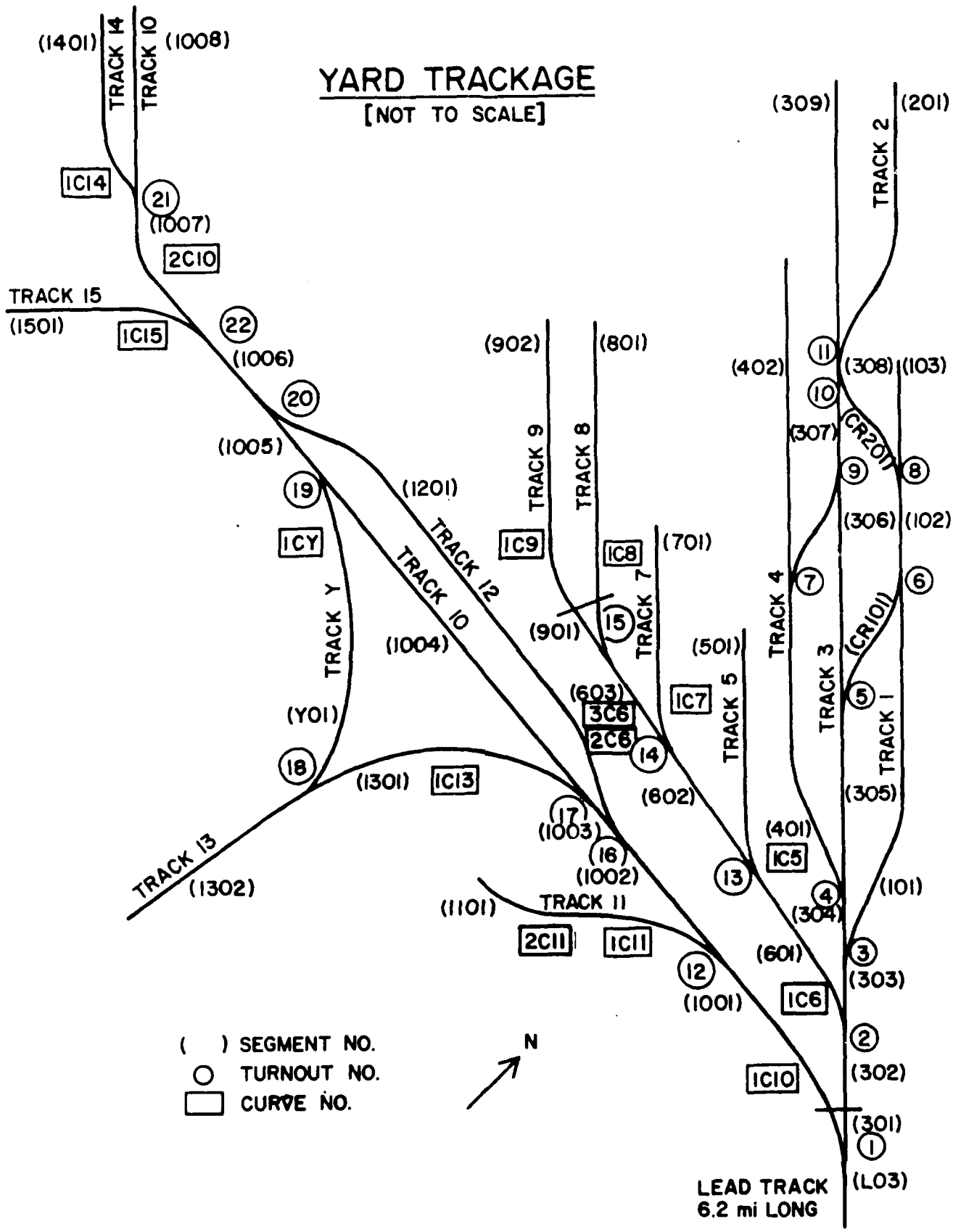
12. Accomplish all key planning items as soon as possible.

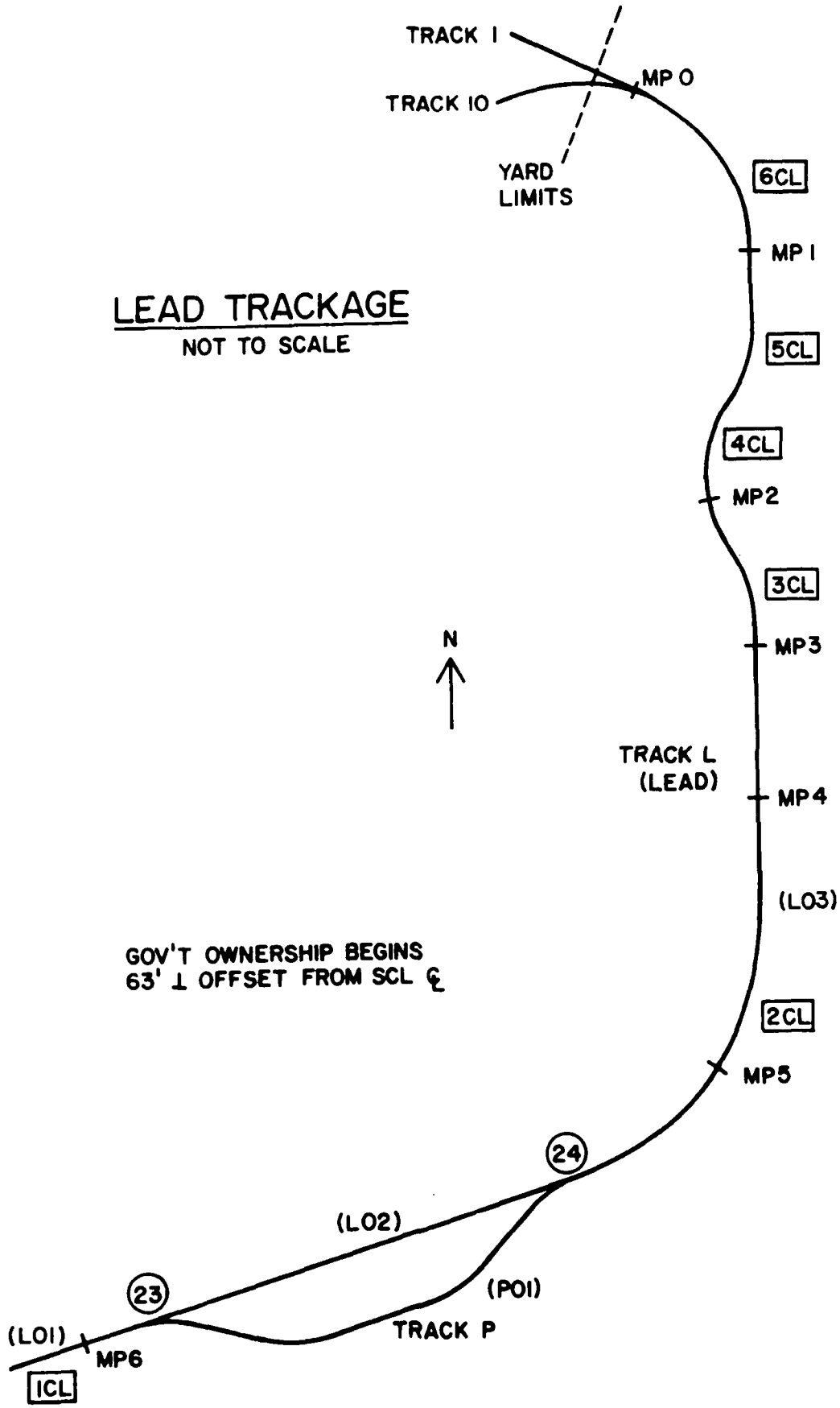
13. The supervisor will work with each of the crews to some extent.

14. Data loading, extensive number crunching, and analysis work will be performed back at USACERL upon return.

APPENDIX C:

FINAL SEGMENTED MAP


YARD TRACKAGE
[NOT TO SCALE]
(1401)
TRACK 14
TRACK 10
(1008)
1C14
21
(1007)
2C10
TRACK 15
(1501)
1C15
22
(1006)
20
(1005)
19
1CY
TRACK Y
(Y01)
18
(1301)
1C13
TRACK 13
(1302)
(1201)
TRACK 12
TRACK 10
(1004)
(902)
TRACK 9
(801)
TRACK 8
1C9
1C8
(701)
TRACK 7
(901)
15
(603)
3C6
2C6
14
(602)
17
(1003)
16
(1002)
(1101)
TRACK 11
2C11
1C11
12
(1001)
(501)
TRACK 5
1C7
(309)
(201)
TRACK 2
(402)
11
(308)
(103)
10
(307)
CR201
9
8
(306)
(102)
TRACK 4
7
6
CR101
TRACK 3
5
TRACK 1
(305)
(401)
1C5
13
4
(304)
(101)
(601)
3
(303)
1C6
2
(302)
1C10
(301)
1
(L03)
LEAD TRACK
6.2 mi LONG
( ) SEGMENT NO.
TURNOUT NO.
CURVE NO.
N



LEAD TRACKAGE

NOT TO SCALE

GOV'T OWNERSHIP BEGINS
63' ⊥ OFFSET FROM SCL ℄

APPENDIX D:

RAILER REPORTS

Ft. Stewart, GA — RAILER — Page: 1
01/27/1989
INSTALLATION NETWORK INFORMATION REPORT

INSTALLATION #: 13305 — PRIMARY INSTALLATION NUMBER: 13305

INSTALLATION TRACKAGE

TRACK #	TRACK LENGTH	# OF SEGMENTS
1	2922 TF	3
10	8195 TF	8
11	387 TF	1
12	1364 TF	1
13	2304 TF	2
14	2413 TF	1
15	1188 TF	1
2	1099 TF	1
3	4884 TF	9
4	2479 TF	2
5	349 TF	1
6	1375 TF	3
7	313 TF	1
8	1113 TF	1
9	1555 TF	2
CR1	165 TF	1
CR2	165 TF	1
L	32639 TF	3
P	2230 TF	1
Y	778 TF	1

TOTAL # OF SEGMENTS = 44
TOTAL TRACK LENGTH = 68538 TF

01/27/1989

TRACK SEGMENT INVENTORY INFORMATION REPORT

INSTALLATION #: 13305 PRIMARY INSTALLATION NUMBER: 13305

SEGMENT IDENTIFICATION

Track Segment #	Begin/End Location (station)	Track Length (feet)	Track Category	Track Use	Track Rank	Construction Code/ Preceding Track Segment #(s)
1001	0+99 10+58	959	B	Access	0.000	P 301

Comments:

TRACK STRUCTURE

			RAIL		
Track Segment #	Begin Location (station)	End Location (station)	Length (feet)	Weight (lbs/yd)	Section
1001	0+99	1+14	30	115	RE
1001	1+11	1+21	20	100	RE
1001	1+21	10+58	1868	85	ASCE

	FASTENINGS			TIES			BALLAST	
Tie Plate Length (in)	Shoulder	Rail Anchors	Gauge Rods	Cross Section (in x in)	Spacing (in)	Material	Support Depth (in)	Type
13.00	DS	N	N	6X8	22.02	Wood		Rock
Comments:								
11.00	DS	N	N	X		Wood		Rock
Comments:								
9.00	SS	Y	Y	X		Wood		Rock
Comments: 3 gage rods were found in this track structure section, and 100 rail anchors were found in one 200 ft. length.								

TURNOUTS

Track Segment #/ Turnout #	Switch Pt Location (station)	Direction	Point Length (LF)	Rail Weight Change	Frog Type/ Frog Size	Guard Rail Length (LF)
1001 12	9+69	LH	15.0	N	SELF GUARDED 8	
Reversing Tangent = 50 ft Past Frog: N						
Comments: Provides access to track 11						

CURVES

Track Segment #	Curve ID #	Curvature (degrees)	Required Superelevation (inches)	Desired Speed (mph)
1001	1C10	5.00	0.00	5
Comments:				

DRAINAGE STRUCTURES

Track Segment #	Centerline Location	Type	Size (inches)	Material
1001	6+74	Pipe culve	40	Steel
Comments:				
1001	3+39	Pipe culve	50	Steel
Comments:				

Report Criteria: Condition Comparison by Inspection Type Report for All Track Segments.

TRACK SEGMENT #	NO OPERATION	5 MPH SPEED LIMIT	10 MPH SPEED LIMIT	FULL COMPLIANCE	DEFECT FREE
1001					
	TURNOUTS		RAIL & JOINTS	TIES TRACK COMP TURNOUT GEOM	VEGETATION
1002					
			TURNOUTS	RAIL & JOINTS TIES TRACK COMP TURNOUT GEOM	VEGETATION
1003					
				TIES TURNOUT GEOM	RAIL & JOINTS TRACK COMP TURNOUTS VEGETATION
1004					
				TIES TRACK COMP	VEGETATION
1005					
			TURNOUTS	TRACK COMP TURNOUT GEOM	RAIL & JOINTS TIES VEGETATION
1006					
		TURNOUTS	TIES	RAIL & JOINTS TRACK COMP TURNOUT GEOM VEGETATION	
1007					
	FLANGEWAY MEA		TIES	RAIL & JOINTS TRACK COMP TURNOUTS VEGETATION	TURNOUT GEOM
1008					
			TIES	RAIL & JOINTS TRACK COMP	VEGETATION
101					
	FLANGEWAY MEA TIES			TRACK COMP	RAIL & JOINTS VEGETATION
102					
	FLANGEWAY MEA	TURNOUT GEOM	VEGETATION	TIES	RAIL & JOINTS

Report Criteria: Condition Comparison by Inspection Type Report for All Track Segments.

TRACK SEGMENT #	NO OPERATION	5 MPH SPEED LIMIT	10 MPH SPEED LIMIT	FULL COMPLIANCE	DEFECT FREE
	TURNOUTS			TRACK COMP	
103			TIES	TRACK COMP VEGETATION	RAIL & JOINTS
1101			RAIL & JOINTS	TIES TRACK COMP VEGETATION	
1201	FLANGEWAY MEA		RAIL & JOINTS TIES	TRACK COMP VEGETATION	
1301				TIES TRACK COMP	RAIL & JOINTS VEGETATION
1302		TIES	TURNOUTS	FLANGEWAY MEA RAIL & JOINTS TRACK COMP	TURNOUT GEOM VEGETATION
1401				TIES TRACK COMP	VEGETATION
1501					RAIL & JOINTS TIES TRACK COMP VEGETATION
201	FLANGEWAY MEA			RAIL & JOINTS TRACK COMP VEGETATION	TIES
301		TURNOUTS		TURNOUT GEOM	RAIL & JOINTS TIES TRACK COMP VEGETATION
302		TURNOUTS	TURNOUT GEOM	TIES TRACK COMP	RAIL & JOINTS VEGETATION

Report Criteria: Condition Comparison by Inspection Type Report for All Track Segments.

TRACK SEGMENT #	NO OPERATION	5 MPH SPEED LIMIT	10 MPH SPEED LIMIT	FULL COMPLIANCE	DEFECT FREE
303	TURNOUTS	TURNOUT GEOM	RAIL & JOINTS TIES	TRACK COMP	VEGETATION
304	FLANGEWAY MEA	TURNOUTS		TIES TRACK COMP TURNOUT GEOM	RAIL & JOINTS VEGETATION
305	FLANGEWAY MEA	TURNOUTS		TIES TRACK COMP TURNOUT GEOM	RAIL & JOINTS VEGETATION
306	FLANGEWAY MEA		TIES	RAIL & JOINTS TRACK COMP	VEGETATION
307			TURNOUT GEOM TURNOUTS	RAIL & JOINTS TIES TRACK COMP	VEGETATION
308			TURNOUT GEOM TURNOUTS	RAIL & JOINTS TRACK COMP VEGETATION	TIES
309	FLANGEWAY MEA			RAIL & JOINTS TIES TRACK COMP VEGETATION	
101	FLANGEWAY MEA			TIES TRACK COMP	RAIL & JOINTS VEGETATION
102				RAIL & JOINTS TIES TRACK COMP VEGETATION	
501				RAIL & JOINTS TIES	

Report Criteria: Condition Comparison by Inspection Type Report for All Track Segments.

TRACK SEGMENT #	NO OPERATION	5 MPH SPEED LIMIT	10 MPH SPEED LIMIT	FULL COMPLIANCE	DEFECT FREE
				TRACK COMP VEGETATION	
601					
	TURNOUTS			TIES TRACK COMP TURNOUT GEOM	RAIL & JOINTS VEGETATION
602					
				TIES TRACK COMP TURNOUTS VEGETATION	RAIL & JOINTS TURNOUT GEOM
603					
	FLANGEWAY MEA		TIES	TRACK COMP TURNOUT GEOM TURNOUTS VEGETATION	RAIL & JOINTS
701					
	TIES			TRACK COMP VEGETATION	RAIL & JOINTS
801					
	FLANGEWAY MEA			RAIL & JOINTS TIES TRACK COMP VEGETATION	
902					
	FLANGEWAY MEA			TIES TRACK COMP VEGETATION	RAIL & JOINTS
CR101					
			FLANGEWAY MEA		RAIL & JOINTS TIES TRACK COMP VEGETATION
CR201					
	FLANGEWAY MEA				RAIL & JOINTS TIES TRACK COMP VEGETATION
101					

Report Criteria: Condition Comparison by Inspection Type Report for All Track Segments.

TRACK SEGMENT #	NO OPERATION	5 MPH SPEED LIMIT	10 MPH SPEED LIMIT	FULL COMPLIANCE	DEFECT FREE
		TURNOUTS	TURNOUT GEOM VEGETATION	RAIL & JOINTS TIES TRACK COMP	
L02			TIES VEGETATION	TRACK COMP	RAIL & JOINTS
L03	FLANGEWAY MEA RAIL & JOINTS	TIES TURNOUTS	TURNOUT GEOM	TRACK COMP VEGETATION	
P01		TIES		VEGETATION	RAIL & JOINTS TRACK COMP
Y01				RAIL & JOINTS TIES TRACK COMP	VEGETATION

Condition After Repairs: Full Compliance Track Category: All
Policy: IN-HOUSE Track Use: All

Track Segment #	Maintenance Standard Condition	Total Cost to Raise Condition to Desired Level
1001	NO OPERATION	$406.00
1002	10 MPH SPEED LIMIT	$0.00
1005	10 MPH SPEED LIMIT	$10.00
1006	5 MPH SPEED LIMIT	$728.00
1007	NO OPERATION	$818.00
1008	10 MPH SPEED LIMIT	$700.00
101	NO OPERATION	$1,327.00
102	NO OPERATION	$282.00
103	10 MPH SPEED LIMIT	$991.00
1101	10 MPH SPEED LIMIT	$350.00
1201	NO OPERATION	$700.00
1302	5 MPH SPEED LIMIT	$2,339.00
201	NO OPERATION	$0.00
301	5 MPH SPEED LIMIT	$30.00
302	5 MPH SPEED LIMIT	$28.00
303	NO OPERATION	$994.00
304	NO OPERATION	$10.00
305	NO OPERATION	$0.00
306	NO OPERATION	$291.00
307	10 MPH SPEED LIMIT	$0.00
308	10 MPH SPEED LIMIT	$10.00
309	NO OPERATION	$0.00
401	NO OPERATION	$0.00
601	NO OPERATION	$61.00
603	NO OPERATION	$291.00
701	NO OPERATION	$2,072.00
801	NO OPERATION	$0.00
902	NO OPERATION	$0.00
CR101	10 MPH SPEED LIMIT	$0.00
CR201	NO OPERATION	$0.00
L01	5 MPH SPEED LIMIT	$71.00
L02	10 MPH SPEED LIMIT	$1,227.00
L03	NO OPERATION	$8,766.00
P01	5 MPH SPEED LIMIT	$3,556.00
		$26,640.00

Note: The policy chosen may not allow the selected track segment(s) to be raised to the desired operating or condition level.

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